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Correlates and effects of information, motivation and behavioral skills on primary sexual abstinence among female university students in Ethiopia: a cross-sectional study

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Abstract

Background The burden of sexually transmitted infections (STIs) and unintended pregnancies continue to pose significant public health challenges, disproportionately affecting young women. The information-motivation-behavioral (IMB) skills model is useful for understanding risky and safe sexual behavior. However, while the IMB models have been used primarly to understand and promote HIV prevention with condom use behavior, there is limtted research using the IMB model to understand and promote safer sexual dual-protection behaviors, such as abstinence, to address the risk of both STI/HIV and unwanted pregnancy among youth in Ethiopia. This study aimed to fill this gap by applying the IMB model to assess the correlates and effects of information, motivation, and behavioral skills on primary sexual abstinence among female university students in Ethiopia.

Methods A cross-sectional study was conducted with a sample of 1,020 female university students at Mattu University between May and June 2023. Data were collected using a self-administered questionnaire and analyzed using SPSS version 23. Descriptive statistics were used to summarize the percentage distribution of participants by their sociodemographic characteristics and levels of HIV risk reduction/dual protection information, motivation, behavioral skills, and risky and safer sexual behaviors. Bivariate and multivariate analyses were conducted using structural equation modeling (SEM) with AMOS 23 to examine the correlations and effects of information, motivation, and behavioral skills on primary sexual abstinence.

Results Of 1,020 participants, 624 (61.2%) reported having practiced primary sexual abstinence.Multivariate analyses showed that primary sexual abstinence was significantly predicted by motivation ($\beta = 0.34$, $P < 0.001$), behavioral skills ($\beta = 0.24$, $P < 0.001$) and information ($\beta = 0.11$, $P < 0.001$) after controlling for the effects of other confounding variables. Overall, approximately 28% of the variance in primary sexual abstinence was explained by the IMB model constructs.

Conclusions The findings indicate that the IMB model is a useful tool for identifying powerful determinants of sexual abstinence, which has potential implications for interventions aimed at enhancing specific information, motivation, and behavioral skills to promote sexual abstinence and reduce the risk of HIV/STI and unintended pregnancy among youth in settings with high HIV burdens.

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Introduction

Globally, HIV/AIDS and unwanted pregnancies remain major public health problems, with young women being disproportionately affected. In 2020, an estimated 1.5 million people were newly infected with HIV globally [1]. In sub-Saharan Africa, women and girls account for 63% of new HIV infections, with 83% occurring among adolescent girls and young women aged 15–24 years [1, 2]. In Ethiopia, although trends in the rates of HIV among adults declined from 1.5% in 2011 to 0.93% in 2019, women continued to be disproportionately affected compared with men (1.22% versus 0.64%), and the highest prevalence occurred among unmarried women (9%) [3–6]. In addition, the rates of unwanted pregnancies among young women in Ethiopia remains high, with about 37% of unwanted pregnancies occurring in young women aged 20–24 years in 2011 [5]. Recent data also indicated that the proportion of young girls who begun childbearing before age 20 was 28% in 2016 [7].

The fact that young women in sub-Saharan Africa are substantially affected by the HIV epidemic and unintended pregnsncy is because they face several vulnerabilities that increase their sexual risk of STIs/HIV and unwanted pregnancy.These vulnerabilities are rooted in gender roles/social norms, and their limited access to sexual health information, education and resources, all of which prevent them from making essential decisions about their sexual health, with most lacking the knowledge and skills needed to protect themselves from HIV infections and unwanted pregnancy [1, 2, 8].

In efforts to combat the spread of HIV infections, HIV/AIDS prevention programs have emphasized safer sexual behaviors such as abstinence, mutual monogamy, and condom use to reduce the risk of HIV infection among youth [2]. Likewise, HIV/AIDS prevention programs in Ethiopia focus their messages and efforts on three aspects of sexual behaviour: such as condom use, limiting sexual partners, and delaying sexual debut (abstinence) among unmarried youth [5]. Despite this, recent studies on sexual behaviors of students in Ethiopia indicated a rising trend in premarital sexual activity among university students, while the rates of condom use among sexually active young women remained low [9, 10]. In addition, because young women are at increased risk of STI/HIV infections and unwanted pregnancy from the same unsafe sexual activity, the recent WHO/UNAIDS recommendation on HIV prevention for young women emphasizes the need for dual protection: safer sexual behaviors that provide simultaneous protection against both HIV/STI and unwanted pregnancy through abstinence, consistent condom use, or dual-method use as comprehensive strategies for youth in settings with high HIV burden [1, 2].

To achieve maximum protective effects, while abstinence is the most effective (100%) way to avoid risks of both STI/HIV and unwanted pregnancy among youth who choose it, and is recommended for unmarried youths in many societies and cultures in Africa, little is known about correlates and effects of knowledge, motivation, and behavioral skills on sexual abstinence based on theoretical models among youth in Ethiopia. Hence, the use of theoretical models is essential to better understand the patterns and determinants of sexual abstinence and designing targeted interventions to promote safer sexual behaviors, including abstinence among youths in settings with high HIV burdens, such as Ethiopia.

Theoretical Perspectives

To date, various behavioral theories have been used to understand HIV risk behaviors and promote safer sexual behaviors across populations at-risk. Of these, the information-motivation-behavioral skills model [11–13] is one that has been widely used and received considerable empirical support in terms of its comprehensiveness, specification of relationships, and ease of translation into empirically-based targeted interventions for particular populations [14, 15]. The IMB model asserts that HIV prevention information, motivation, and behavioral skills are fundamental determinants of HIV preventive behaviors [11–13]. The IMB model specifies that information and motivation work largely through behavioral skills to influence HIV-preventive behaviors. The model also assumes that information and motivation may have a direct effect on preventive behavior when complicated behavioral skills are not necessary for practice, such as abstinence, as opposed to using condoms by young women [11, 12, 16].

The IMB model's constructs are also regarded as highly generalizable determinants of sexual health behaviors across populations and behaviors of interst [7, 11, 14, 15, 17]. Within the model, it is assumed that specific information, motivation, and behavioral skills contents should be most relevant to a specific preventive behavior (abstinence or condom use). The IMB model suggests that specification of information, motivation, and behavioral skills content most relevant to a specific preventive

behavior and identification of the IMB model constructs that most strongly influence the practice of preventive behavior are crucial for designing empirically targeted interventions for specific populations [7, 11–13, 17, 18]. However, despite the recommendation for its application to a range of safer sexual behaviors, research using the IMB model to understand and promote safer sexual dual-protection behaviors, such as abstinence among youths in Ethiopia remains limited. As a result, little is known about the relative influence of information, motivation, and behavioral skills on sexual abstinence among youths in Ethiopia. Therefore, this study aimed to fill this gap by using the IMB model to assess the correlates and effects of information, motivation, and behavioral skills on primary sexual abstinence among female university students in Ethiopia. These will not only advance our theoretical understanding of sexual behavior in high HIV burden settings but also inform the development of targeted interventions that address the specific needs of this population.

Conceptual framework for the present study

Applying the IMB model to understand the determinants of primary sexual abstinence, as depicted in Fig. 1, we hypothesized that higher levels of sexual risk dual protection information, motivation, and behavioral skills would predict primary sexual abstinence among unmarried female students. Specifically, having specific information about the sexual risks of HIV/pregnancy and the benefits of abstinence, greater motivation to practice abstinence (positive attitudes toward abstinence and supportive norms about abstinence), and the behavioral skills required for abstinence (perceived ability to refuse sex and self-efficacy for abstinence) will directly determine the practice of primary sexual abstinence. Information and motivation may also affect behavioral skills, indirectly affecting primary sexual abstinence. This means that behavioral skills can partially mediate the effects of information and motivation on primary sexual abstinence (see Fig. 1).

Materials and methods

Study setting and period

This study was conducted at Mattu University in Ethiopia. Mattu University is a newly established third-generation public university in the country. It has two campuses: the Mattu main campus, located at 551 km southwest of Addis Ababa, and Bedele campus, located at 431 km southwest of Addis Ababa. This study was conducted between April and December 2023.

Study design

A cross-sectional survey was used to assess the levels and correlates of information, motivation, behavioral skills, and risky and safer sexual behaviors and identify deficits in information, motivation, and behavioral skills
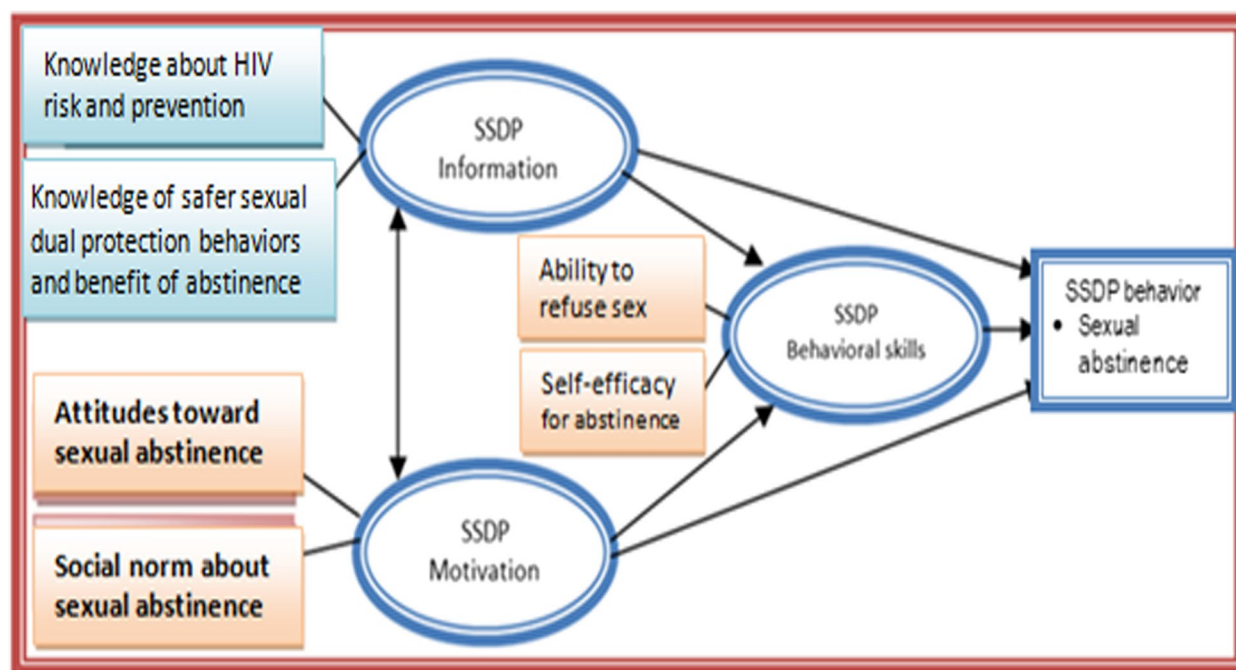
Fig. 1 Conceptual framework for the IMB model of primary sexual abstinence Adopted from [7]

that are associated with risky sexual practices in order to guide the design of targeted interventions for these populations.

Participants
The source populations were all female university students in two campuses of Mattu University. The study population consisted of female students in randomly selected colleges/departments during the study period. The inclusion criterion was that being female students attending non-health programs, willing to participate and provide informed consent, whereas students in health sciences programs and those who were critically ill were excluded from the study.

Sample size and its determination
To obtain a sufficient number of participants for the numerical analysis, the sample size for the study was calculated for different objectives, and the largest size was taken as the fina size. Accordinglly, the sample size for the intervention study was determined using the formula for two proportion comparisons based on the 2016 EDHS (CSA, 2016)for the proportion of young women reporting condom use at last sex (p = 0.24), and the anticipated increase in the percentage of dual protection use at post-intervention to 44% (P2 = 0.44), considering an allowed margin of error of 5% (d = 0.05), with a 95% CI and a power of 90% (1- β) for detecting a 20% difference between the two groups (Δ = 0.20), yielding a total sample size of n = 1,050.

$$n = \frac{2\left(z_{\alpha/2} + z_{1-\beta}\right)^2}{\frac{(\mu 1 - \mu 2)^2}{\delta}} = \frac{2(1.96 + 1.28)^2}{\left(\frac{\Delta}{\delta}\right)^2} = \frac{2(10.51)}{\delta^2} = \frac{21}{(0.20)^2} = \frac{21}{0.04} = 525 \times 2 = 1050$$

Thus, since 1,050 was the largest sample size calculated, it was taken as the final sample size to be used for all objectives, including the present study.

Sampling technique
A multistage sampling technique was used to recruit participants from two campuses of Mattu University. First, three non-health colleges were selected using stratified sampling from each campus.Then; two departments from each college were selected using random sampling. Finally, two classrooms, with 2nd and 3rd year levels, from each department were selected in which all female students who fulfilled the inclusion criteria were invited to participate in the study.

Measurement
To assess levels of HIV risk reduction/dual protection information, motivation, behavioral skills, and behaviors, a validated measure of the IMB model of HIV prevention behaviors from previous research [7, 11, 14, 15, 17, 19] was adopted for this study.

A/Measures of Information
Levels of HIV risk reduction and dual protection information were assessed with12 items using T/F responses. i) Knowledge of HIV risk and prevention was assessed with eight items, such as (1) "HIV can be transmitted through sexual intercourse"; 2) "Abstinence is the most effective way to avoid risk of STI/HIV"; or 3) "Consistent condom use is an effective in preventing STI/HIV". ii) Knowledge of safer sexual dual protection behaviors was assessed with 4 items, such as (1) "Abstinence is the best way to avoid the risk of HIV/STI and pregnancy for unmarried youth"; (2) "Consistent condom use prevents HIV/STI and pregnancy, providing dual protection against both"; and (3) "Dual methods use is options for dual protection against both HIV/STI and pregnancy simultaneously,".

B/Measures of Motivation
Motivation to practice abstinence was assessed on the basis of attitudes and social norms regarding abstinence, using 5 pionts Likert scale: (a) Attitude toward abstinence was assessed with 2 items: (e.g., 1) Abstinence can prevent youth from becoming pregnant and HIV/STI, and 2) "Abstinence can foster the attainment of career goals" and (b) Social norms about premarital sex/abstinence were assessed with 2 items: (e.g., 1) "Most people who are important to me think I should abstain from sex" and 2) "Having sex before marriage is against my religion,"

C/Measures of behavioral skills
Behavioral skills for practicing abstinence were assessed with 2 items, using 5 pionts Likert scale: a) Perceived ability to refuse sex (eg., "How confident are you that you are able to refuse sex?"), b) Self-efficacy for abstinence (eg., "How effectively could you maintain abstinence, even if you are pressured by friends?".

D/ Measures of safer sexual dual protection behaviors
Sexual practices were measured on the basis of self-reported sexual activities and method used.

1) Primary sexual abstinence was assessed by asking "Have you ever had sex to date?" with a response (yes or no).

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2) Dual protection use was assessed by asking, "Did you use the dual protection method at last sex in the past 12 months"? with a response option (yes/no).

3) Consistent condom use was assessed by asking "how frequently did you use condoms in the past 12 months?" with responses options (1) "always" to (2) "never."

4) Dual method use was assessed by asking "Did you use condoms plus other contraceptive methods in the past 12 months" with responses (yes or no).

Operational definition

a) ***Primary sexual abstinence***: is definded as never having sex at all

b) ***Dual protection*** is defined as simultaneous protection from pregnancy and STI/HIV infection through the consistent use of condom alone, the use of two methods (condom plus other contraceptive methods), or abstinence.

c) ***Consistent condom use*** is defined as always using a condom in every sexual encounter

d) ***Knowledge of safer sexual dual protection behaviors*** was measured with 4 items, using T/F response. If the student answered the mean score and above, she was considered having high knowledge and low knowledge otherwise.

e) ***Attitudes toward abstinence*** were assessed with 2 items, using 5 pionts Likert scale. If the student answered the mean score and above, she was considered having positive attitude and negative attitude otherwise

f) ***Social norms about abstinence*** were assessed with two items, using 5 pionts Likert scale. If the female student answered the mean score and above, she was considered having supportive norms and unsupportive norms otherwise.

g) ***Perceived ability /self-efficacy for abstinence*** were assessed with two items, using 5 pionts Likert scale. If the student answered the mean score and above, she was considered having high perceived ability/self-efficacy and low perceived ability/self-efficacy otherwise.

Data collection instruments and procedure

Data collection was conducted using a self-administered questionnaires prepared in English and then translated into two native languages, Afaan-Oromoo and Amharic, for better understanding of students on concepts in each question. The questionnaires were administered by 4 research teams holding a B.Sc. degree; specifically, two

had a B.Sc. in Health Officers (HO) and two had a B.Sc. in Nursing, but not staff of same university, and trained as supervisors to help students complete the questionnaire. As a means of quality control, a pre-test of the questionnaire was administered to 5% of the sample not taking part in the study.

Data analysis

The collected data were cleaned, edited, and analyzed using SPSS version 23. Descriptive statistics were used to summarize the percentage distributions of participants by demographic characteristics and level of HIV risk reduction/dual protection information, motivation, behavioral skills, and behaviors. To examine correlates and effects of the IMB model on primary sexual abstinence, bivariate and multivariate analyses were performed using SEM with AMOS 23 [20, 21]. Specification of the present SEM was guided by the IMB model [13, 14, 17, 18]. The fit of the model to the observed data was assessed using various fit indices provided by AMOS, including the chi-square test value ($p > 0.05$), the comparative fit index value (CFI > 0.90), and the root mean square error of approximation value (RMSEA < 0.05), all indicating a better fit. Estimatation of the parameters for the measurement model (confirmatory factor analysis) and the structural model (path analysis) was accomplished with maximum likelihood estimate in AMOS. Confirmatory factor analysis was used to examine the relationships between the observed variables and latent constructs in the model (i.e., to test the reliability of the measurement model). Path analysis was used to examine the relationships between the latent constructs of the model (i.e., the structural model) to determine the direct and mediated effects of the IMB model in predicting primary sexual abstinence. The threshold for significance was set at $p < 0.05$.

Ethical consideration and informed consent to participate

Ethical approval was obtained from the Institutional Review Board (IRB) of Jimma University with reference number: JUHI/IRB 329/23, date 20/03/2023, which states that "the research protocol meets the ethical and scientific standards outlined in national and international guidelines" or in accordance with the Declaration of Helsinki. A formal letter of support was obtained from the responsible bodies of Mattu University to their respective colleges and departments.

Informed consent was obtained from all the participants based on "written consent form" prepared for this purpose. As all university-level students are older than 18 years, they are believed to be capable of providing informed consent. Further, the law in Ethiopia does not require such a group of young people to be accompanied

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by parents or guardians to provide consent to their behaviors, clarifying and stating that "Assent will be sought from a study participant under the age of 18 years old" (NRERG 7th ed: Art 6.15) [9]. Before starting, the study objective was explained to the participants in their native language, and voluntary participation was allowed by explaining the participants' full rights to participate and to change their decision or withdraw their informed consent at any stage without giving any reason or penalty. The participants were also assured that the questionnaire was anonymous and that their responses were fully confidential.

Results

Descriptive statistics

    I Sociodemographic characteristics and sexual behaviors of the participants

As presented in Table 1, of the 1,020 participants, 820 (80.4%) were aged 20–24 years, with a mean age of 20.77 years (SD = 1.146). In terms of ethnicity, 526 (51.6%) were Oromos, followed by Amhara (356; 34.9%). According to their religion, 442 (43.3%) were Orthodox, 364 (35.7%) were Protestants, 180 (17.6%) were Muslims, and 34(3.3%) were Waaqeffataa. With regard to sexual practice, 624 (61.2%) reported never having sexual intercourse, whereas 396 (38.8%) have ever had sexual intercourse. Among those who were sexually active in the past 12 months ($n = 370$), about 175 (47.3%) used condoms at their last sexual encounter, while only 76 (20.5%) of them used dual protection methods in the past year, with 22 (5.9%) using condoms alone for dual purposes and 54 (14.6%) using a two-method approach (condom plus hormonal methods) at their last sexual encounter (see Table 1).

    ii. Levels of HIV risk and dual protection information, motivation and behavioral skills among the study participants

Table 1 Distribution of the study participants by demographic characteristics and sexual behaviors (n = 1020)

Variables		Number	%
Demographic characterstics			
Age group	15–19	170	16.7
	20–24	820	80.4
	25–29	30	2.9
Ethnic groups	Oromoo	526	51.6
	Amhara	356	34.9
	Sidama	111	10.9
	Others[a]	27	2.6
Religious group	Waaqeffannaa	34	3.3
	Protistant	364	35.7
	Ortodox	442	43.3
	Musilims	180	17.6
Place of residence	Urban	466	45.7
	Rural	554	54.3
Sexual behaviors			
Ever had sexual intercourse (*n* = **1,020**)	**Yes**	**396**	38.8
	No	624	61.2
Sexual activity in the past 12 months (*n* = **396**)	**Yes**	**370**	93.4
	No	26	6.6
Condom use at last sex in the past 12 months (*n* = **370**)	**Yes**	**175**	47.3
	No	195	52.7
Frequency of condom use in the past 12 months (*n* = **175**)	**Always/every time**	**69**	**18.6**
	Some times	106	28.5
Dual protection methods use for preventing STI/HIV and pregnancy in the past 12 months **(n = 370)**	**Yes**	**76**	**20.5**
	No	294	79.5
Types of dual protection methods used (**consistent condom use alone or dual methods use**) **(n = 76)**	**Consistent condom use**	*22*	*5.9*
	Two methods use	*54*	*14.6*

[a] = Represents other ethnic groups including Gorage, Walayitta, Tigre and Hadiya

As presented in Table 2, regarding information about HIV risk reduction and dual protection, about two-third, (66.6%) of participants had higher knowledge of HIV risk and prevention, while only half, 522(51.2%) had higher knowledge of safer sexual dual protection behaviors. Concerning motivation to practice abstinence, fewer than half, 474 (46.5%) had a positive attitude towards abstinence, and 442(43.3%) had supportive norms for abstinence. Regarding behavioral skills for abstinence, 493(48.3%) perceived their ability or self-efficacy for abstinence (see Table 2).

Bivariate analysis of correlations among constructs of IMB model and sexual abstinence

As shown in Table 3, results of Spearman's correlations analysis indicate that knowledge of HIV risk reduction and knowledge of safer sexual dual protection behaviors were strongly correlated with the motivational indicators of attitudes toward abstinence ($r = 0.073$, $p < 0.05$) and social norms about abstinence ($r = 0.076$, $p < 0.05$), but not correlated with behavioral skill indicator of self-efficacy for practicing abstinence ($r = 0.004$, $p > 0.05$). In addition, the motivational indicator of attitude

Table 2 Summary statistics of the levels of HIV risk reduction /dual protection information, motivation, behavioral skills among female university students (*n* = 1020)

Variables		Frequency	%	Mean	SD	α
Information						
Knowledge about HIV risk and prevention	**High**	679	66.6	6.18	1.395	.56
	Low	341	33.4			
Knowledge of safer sexual dual protection behaviors	**High**	522	51.2	2.79	1.023	.66
	Low	498	48.8			
Motivation						
Attitudes toward abstinence	**Positive**	474	46.5	3.3	1.84	.97
	Negative	546	53.5			
Perceived social norms about abstinence	**Supportive**	442	43.3	3.44	1.48	.89
	Unsupportive	578	56.7			
Behavioral skills						
Perceived ability/ self-efficacy for abstinence	**High**	493	48.3	3.57	1.58	.91
	Low	527	51.7			

Table 3 Correlations among indicators of information, motivation and behavioral skills and primary sexual abstinence among female university students in Ethiopia (*n* = 1020)

	Spearman's Correlations (r)							
	Variables	**1**	**2**	**3**	**4**	**5**	**6**	
1	Knowledge about HIV risk reduction	1						
2	Knowledge about ssdp behaviors	.593[b]	1					
3	At Attitude toward sexual abstinence	.051	.073[a]	1				
4	Social norms about abstinence	.051	.076[a]	.711[b]	1			
5	Self-efficacy to maintain abstinence	-.016	.004	.454[b]	.365[b]	1		[a]
6	*Primary sexual abstinence*	***.110[b]***	***.111[b]***	***.474[b]***	***.360[b]***	***.390[b]***	*1*	

Key: [b]. The correlation is significant at the 0.01 level (2-tailed)

[a] . Correlations are significant at the 0.05 level (2-tailed)

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towards sexual abstinence was strongly correlated with the behavioral skill indicator of self-efficacy for abstinence ($r = 0.454$, $p < 0.001$). Overall, the bivariate analysis showed that the primary sexual abstinence is significantly correlated with knowledge about HIV risk and prevention ($r = 0.110$, $p < 0.001$), knowledge of safer sexual dual protection behaviors ($r = 0.111$, $p < 0.001$), attitude towards abstinence ($r = 0.474$, $p < 0.01$), social norms about abstinence($r = 0.360$, $p < 0.001$), and perceived self-efficacy for abstinence ($r = 0.390$, $p < 0.01$) (see Table 3).

Multivariate analysis

The test of the model fit to the observed data revealed that the values of a chi-square test ($X^2 = 9.486$, $P = 0.220$), a comparative fit index (CFI = 0.99), and a root mean square error of approximation (RMSEA = 0.019), all indicate that the model fit was acceptable. The results of estimated parameters for the measurement model (confrmatory factor analysis) and the structural model (path analysis) via a maximum likelihood estimate in AMOS are presented as follows:

Confirmatory factor analysis (CFA)

As presented in Table 4, the maximum likelihood estimates of factor loadings for the measurement model showed that there is a strong and statistically significant correlation. The standardized factor loadings for knowledge of HIV risk reduction ($\beta = 0.81$ and knowledge of safer sexual dual protection behaviors ($\beta = 0.98$) on the information construct were strong

Table 4 Maximum likelihood estimates of the measurement model parameters for the IMB model of primary sexual abstinence among female university students (n = 1,020)

Variables			Estimate	S.E	t.value	*P*. value	Standardized factor loading (B)
Information	–>	Knowledge of HIV risk and prevention	1.268	.176	7.20	***	.98
	–>	Knowledge of SSDP behaviors	1.000				.81
Motivation	–>	Attitude toward sexual abstinence	1.020	.033	31.15	***	.93
	–>	Social norms about sexual abstinence	1.000				.91
Behavioral skills	–>	Percieved ability to refuse sex	.912	.038	23.69	***	.86
	–>	Self-efficacy for abstinence	1.000				.93

Indicators with loadings of 1.00 set the metric of the construct
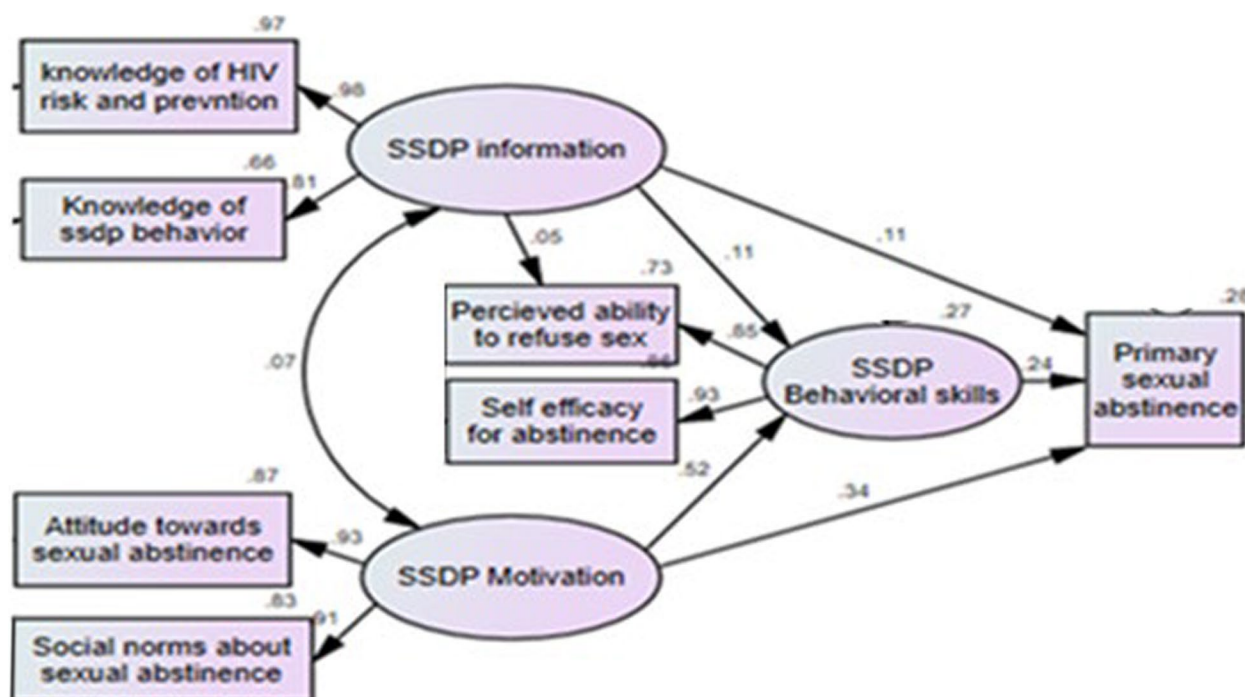
*** = $p < 0.001$

Table 5 Maximum likelihood estimates of the structural model parameters of the IMB model for sexual abstinence among female university students in Ethiopia (*n* = 1,020)

Parameters			Estimate	S.E	t.vale	*P*. value	Standardized path coefficient	R2
Information	–>	Behavioral skills	.147	.036	4.115	***	11	.27
Motivation	–>	Behavioral skills	.521	.033	15.995	***	.52	
Information	–>	Primary sexual abstinence	.147	.036	4.115	***	.11	.28
Motivation	–>	Primary sexual abstinence	.368	.037	9.941	***	.34	
Behavioral skills	–>	Primary sexual abstinence	.254	.037	6.782	***	.24	
Information	<–>	Motivation	.013	.006	2.149	.032	.07	

R2 = represents the proportion of explained variance in the dependent variable that is accounted for by the independent variable

*** = $p < 0.001$

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Fig. 2 Significant regression paths in the IMB model predicting primary sexual abstinence among female university students (*n* = 1,020)

and statistically significant (*P* < 0.001). Likewise, the standardized factor loadings for attitudes toward abstinence (β = 0.93) and social norms about abstinence (β = 0.91) on the motivation construct were strong and statistically significant (*P* < 0.001). Finally, the standardized factor loadings for perceived ability to refuse sex of (β = 0.88) and self-efficacy in practicing abstinence of (β = 0.93) on the behavioral skills construct are strong and statistically significant (*P* < 0.001) (see Table 4).

Path analysis

As shown in Table 5 and Fig. 2, the path analysis coefficient indicate that the IMB model's motivation (β = 0.34, *P* < 0.001), behavioral skills (β = 0.24, *P* < 0.001), and information (β = 0.11, *P* < 0.001) were significant predictors of primary sexual abstinence. Overall, the IMB model's constructs accounted for approximately 28% of the variation in primary sexual abstinence. In addition, the mediational effects analysis revealed that the impacts of information (β = 0.11, *P* < 0.001) and motivation (β = 0.522, *P* < 0.001) on behavioral skills of abstinence were positive and statistically significant. Both the information and motivation constructs accounted for about 27% of the variation in behavioral skills of abstinence. Furthermore, the correlation between information and motivation was significant (*P* < 0.001) (see Table 5 and Fig. 2).

Discussion

The current study utilized the IMB model to examine correlates and effects of information, motivation and behavioral skills on primary sexual abstinence among female university students in Ethiopia. The results indicate that over two-third of female university students have practiced premarital sexual abstinence, while the proportions of participants that engaged in premarital sexual activity can still be considered as high and significant in terms of its associated risks for STI/HIV infections and unwanted pregnancy without use of condom/dual protection. The prevalence of primary sexual abstinence in this study is similar with the results of studies among Wolaita Sodo University students (56.7%) in Ethiopia and the United States (66%) [9, 22]. However, our finding is lower than those of studies at Jimma University (73%) and Mattu secondary school students in Ethiopia (77.3%) reported primary sexual abstinence [10, 23]. The difference may be due to the difference in the study area and time period.

In addotion, while over two-third of students had higher knowledge of HIV risk and prevention, the majority of participants still had a significant knowledge gaps about safer sexual dual protection behaviors, a negative attitude towards abstinence and lower self-efficacy for abstinence in this study. Yet, knowledge of HIV risk and safer sexual behaviors is crucial to enable people to avoid HIV infection, especially for youth, who are often at greater risk because they may have shorter relationships

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and thus more partners or may engage in other risky behaviours [24, 25]. In addition, attitudes and skills for practicing safer sex can affect one's practice of sexual behaviors [26, 27]. The findings of our study is consistent with the results of studies conducted among Wolaita Sodo University students and Mattu secondary school students in Ethiopia, where many students had unfavorable attitude towards safer sex and inadequate skills for practicing abstinence [9, 23].

The results of bivariate correlation analysis among indicators of IMB model and primary sexual abstinence in this study showed that primary sexual abstinence was correlated with having higher knowledge of safer sexual dual protection behaviors, a positive attitude toward abstinence, supportive norms about abstinence, and percieved self-efficacy for abstinence. This finding is consistent with the results of previous studies on the determinants of sexual abstinence among medda walabu university students, in Ethiopia [28] and among high school students in the United States [223] which indicated that having a positive attitude, social support and higher self-efficacy were correlated with sexual abstinence.

In examination of the theorized effects of IMB model in predicting primary sexual abstinence, this study showed that all information, motivation, and behavioral skills were directly and significantly predictive of primary sexual abstinence, supporting the IMB model's assumptions and consistent with the results of the model tests in previous resreach [15, 17, 29, 30]. Overall, the IMB model's constructs accounted for about one-third of the variance in primary sexual abstinence in this study. This finding is consistent with the findings of previous studies with the model, in which the model's constructs accounted for about one-third to one-half of the variance in condom use [15, 17, 30–34]. In addition, analysis of the mediation effects in the model showed that the impacts of information and motivation on behavioral skills were positive and statistically significant. Both information and motivation constructs accounted for about one-third of the variance in behavioral skills needed for abstinence in this study. These findings are also in line with the model's assumption that information and motivation may have a direct effect on behavior when complicated skills are not needed for practice, such as abstinence [15, 17, 30, 32–34].

Furthermore, the findings of this study confirmed the generalizability and utility of the IMB model for understanding and predicting a range of safer sexual behaviors, including abstinence, as recommended in literatures [15, 17, 30, 32–34]. The results also support the IMB model as a paradigm for explaining and predicting sexual health behavior of youth. The findings of this study can

be viewed as having general implications for the design of IMB model-based interventions to promite sexual abstinence for youth at risk in settings with a high HIV burden.

Limitations

This study has several limitations. First, the study focused only on female university students for the purpose of examining patterns and predictors of dual protection use to simultaneously prevent both STI/HIV and unwanted pregnancy, excluding male students for priority concern. Second, the data based on self-reported sexual behaviors may lead to bias arising from socially desirable responses, because sex remains a sensitive topic in Ethiopian culture. However, the use of self adminstared data collection methods and anounmous questioniiares is intended to reduce such bias.Third, the data from the cross-sectional survey can reveal only the associations between variables at a single point in time; thus, it is recommended that future research should focus on longitudinal studies to test the model.

Conclusions

The findings of this study indicate that a sizable percentage of female university students are engaged in premarital sexual practices, which might put them at risk for unintended pregnancy and STI/HIV infection. In addition, the majority of participants had considerable knowledge gaps about safer sexual dual protection behaviors, unfavorable attitudes toward abstinence and perceived lower self-efficacy for abstinence, suggesting that sexual health education needs to address these gaps to reduce sexual risks behaviors for STI/HIV.

This study also confirms the generalizability and utility of the IMB model in predicting a range of safer sexual dual protection behaviors, including abstinence among unmarried youths. By focusing on application of the IMB model to prefict primary sexual abstinence, this study provides novel insights into the interplay of information, motivation, and behavioral skills in promoting abstinence among female university students in Ethiopia. These insights will not only advance our theoretical understanding of sexual behavior in high HIV burden settings but also inform the development of targeted interventions that address the diveres needs of youth.

Finally, a related focus for future IMB model test has to do with a search for possible sex differences in the psychological determinants of premaeital sexual abstinence.

Abbreviations
AMOS	Analysis of Moment Structure
CCU	Consistent condom use
CFA	Confirmatory factor analysis
CFI	Comparative fit index

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DPU	Dual protection use
DMU	Dual methods use
EDHS	Ethiopian Demographic and Health Survey
FHAPCO	Federal HIV Prevention and Control Office
HIV/AIDS	Human Immunodeficiency Virus /Acquired Immunodeficiency Syndrome
IMB	Information-Motivation-Behavioral skills model
RMSEA	Root mean square error of approximation
SEM	Structural Equation Modeling
SSDPB	Safer sexual dual protection behaviors
SRH	Sexual and Reproductive Health
STIs	Sexually Transmitted Infections
UN	United Nations
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNAIDS	United Nations Programme of HIV/AIDS
UNFPA	United Nations Fund for Population Activities
USAID	United States Agency for International Development
WHO	World Health Organization

Supplementary Information

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Supplementary Material 1

Declarations

Competing interests
The authors declare no competing interests.

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